

20-6-19/42

Spectral Method of Determination of the Number and Position of Side  
Chains in the Molecules of Benzene Homologues

ferent construction of the spectra renders possible the spectral identification of the molecules of these substances. Table 2 gives the strip frequency of the pure-electronic transitions within the investigated spectra. All the hydrocarbons investigated have been produced as high-pure compounds at the above mentioned purpose and their purity has been proved. There follows an experimental part with the usual data. There are 1 figure, 2 tables, and 3 Slavic references.

ASSOCIATION: Institute for Physics AN Ukrainian SSR , Institute for  
Organic Chemistry imeni N. D. Zelinskiy AN USSR (Institut fizi-  
ki Akademii nauk USSR, Institut organicheskoy khimii im. N. D.  
Zelinskogo Akademii nauk SSSR)

PRESENTED: May 24, 1957, by B. A. Kazanskiy, Akademician

SUBMITTED: May 24, 1957

AVAILABLE: Library of Congress

Card 3/3

BROUDE, V.L.; YEREMENKO, V.V. [I Eremenko, V.V.]; MEDVEDEV, V.S.;  
PAKHOMOVA, O.S.; PRIKHOT'KO, A.F.

Effect of deformations on the electron spectra of crystals [in  
Ukrainian with summary in English]. Ukr. fiz. zhur. 3 no.2:232-238  
Mr-Apr '58. (MIRA 11:6)

1. Institut fiziki URSR. (High pressure research)  
(Crystals--Spectra)

007-1-1-1-1/26

AUTHORS: Brando, V.L., Izrailovich, Ye.A., Liberman, A.L., Onoprienko, L.I.,  
Pakhomova, O.S., Prishchepko, A.F., and Shatonshteyn, A.I.

TITLE: On Electron Spectra of Aromatic Hydrocarbons and their Deuterated  
Derivatives at 20°K (Ob elektronnykh spektrakh aromaticheskikh  
uglevodorodov i ikh deuterirovannykh proizvednykh pri 20°K)

PERIODICAL: Optika i Spektroskopiya, 1958, Vol 5, Nr 2, pp 115-122 (USSR)

ABSTRACT: The present paper is the first of a series on the ultraviolet  
absorption spectra of deuterated compounds and the changes in the  
molecular and crystal structure produced by deuteration. To obtain  
the hyperfine structure and to observe the small isotopic shifts  
measurements were made at 20°K. The work reported here is also an  
extension of the application of the deuteration methods based on the  
isotopic exchange of hydrogen with liquid deuterium bromide or with  
a solution of  $KND_2$  in liquid  $ND_3$  (Refs 4-10). The results are given  
in Table 1 which shows that using such methods all atoms of hydrogen  
in diphenyl, naphthalene, toluene, n-xylene, durene, penta- and  
hexamethylbenzene may be replaced by deuterium. The preparation  
followed the method described in Ref 10, which gives the method of

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SCV/51-5-5-5/20

On Electron Spectra of Aromatic Hydrocarbons and their Deuterated Derivatives and 2012

calculation of the number of replaced hydrogen atoms  $n$  in a hydrocarbon molecule. The last column of Table 1 shows that the number  $n$  differs only a little from the total number of hydrogen atoms in the hydrocarbon molecule in question. The following hydrocarbons were deuterated: benzene, toluene, m-xylene, n-xylene, mesitylene, durene, hexamethylbenzene, naphthalene, phenanthrene, diphenyl. The constants, such as the boiling point, refractive index, of the original and deuterated substances are given in Table 2. Using polarized light the authors obtained the electron spectra of the crystals listed in Table 2 (both in deuterated and non-deuterated forms). Measurements were made at 20°K and the results are shown in Figs 1-7. The spectral changes produced by deuteration are due, firstly to changes in the energy states of molecules, and secondly to changes in the crystal structure. The first produce spectral shifts towards the short wavelengths by some 100-200  $\text{cm}^{-1}$  and a decrease of frequencies of the molecular vibrations by a factor of 1.04-1.15. The crystal structure changes show up in the polarization ratios for the absorption bands and in the change of spacing between strongly polarized bands. A.L. Liberman (Institute of Organic Chemistry, Academy of Sciences of the U.S.S.R.) prepared pure benzene and alkylbenzenes. A.I. Shatonshteyn and Ye.A. Izrailevich

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SOV/51-5-2-3/26

On Electron Spectra of Aromatic Hydrocarbons and their Deuterated Derivatives at 20°K

(Physico-Chemical Institute imeni Karpov) prepared deuterated compounds. V.L. Broude, M.I. Onopriyenko, O.S. Pakhomova and A.F. Prihot'ko (Institute of Physics, Academy of Science of the Ukrainian S.S.R.) obtained and interpreted the electron spectra. The authors thank Yu. Antonchik for density measurements of the deuterated hydrocarbons and P. Manochkina for help in deuteration of the hydrocarbons. There are 7 figures, 2 tables and 16 references, 14 of which are Soviet, 1 American and 1 English.

ASSOCIATION: Institut fiziki AN UkrSSR; Fiziko-khimicheskii institut im. Karpova (Institute of Physics, Academy of Sciences of the Ukrainian S.S.R.; Physico-Chemical Institute imeni Karpov)

SUBMITTED: July 16, 1957

Card 3/3 1. Hydrocarbons-d--Spectrographic analysis 2. Ultraviolet spectrum  
--Applications

BROUDE, V.L.; YEREMENKO, V.V.; MEDVEDEV, V.S.

Spectra of photoconductivity excitation and luminescence of  
CdS crystals. Zhur.tekh.fiz. 28 no.10:12 0 '58. (MIRA 11:12)  
(Cadmium sulfide crystals--Optical properties)

24(6)

SOV/57-28-10-7/40

AUTHORS:

Broude, V. L., Yeremenko, V. V. Sheynkman, M. K.

TITLE:

Investigation of the Spectral Distribution of Photoconductivity of CdS **Single-Crystals** at 77 and 20°K (Issledovaniye spektral'nogo raspredeleniya fotoprovodimosti monokristallov CdS pri 77 i 20°K)

PERIODICAL:

Zhurnal tekhnicheskoy fiziki. Vol 28, Nr 10, pp 2142-2151 (USSR) <sup>1958</sup>

ABSTRACT:

This is a presentation of the results of an investigation of the spectral distribution of the photocurrent and of the eigentime of the photocarriers at 77 and 20°K, and of the relation of these quantities to the coefficients of light absorption for different wave lengths. The four functions, that of the spectral distribution of the photocurrent  $I_{ph}(\lambda)$ , that of the eigentime  $\tau^0(\lambda)$ , and that of the ratio  $I_{ph}(\lambda)/\tau^0(\lambda)$  on the one hand, and that of the light absorption coefficient  $\kappa$  at the limit of intrinsic absorption on the other were compared carefully. It appeared that no unique relation can be established between these quantities. Hence the dependence of the photosensitivity upon the absorption coefficient is obviously superimposed by a

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SOV/57-28-10-7/40

Investigation of the Spectral Distribution of the Photoconductivity of CdS  
Single Crystals at 77 and 20°K

dependence upon the wavelength of the absorbed light. It results that the fine structure of the spectral distribution of the photosensitivity at low temperatures cannot be explained by a mechanism which is connected with the value of the absorption coefficient, with the influence of the crystal surface and similar phenomena. The explanation is apparently afforded by a parallel action of several mechanism effective either in the absorption of light or in the creation or annihilation of photocarriers. Special notice is given to the little pronounced structure of the spectral distribution of  $\tau^0(\lambda)$  at 77°K in a range where the spectral structure of the photocurrent is expressly evident. This may offer evidence for the fact that it is not possible to explain the spectral structure of photoconductivity by a simple surface recombination of the free carriers. From the considerations advanced in this paper it proceeds that it is necessary to introduce a relation between the quantities determining the photosensitivity of crystals and the frequency of the exciting light. The experimental parameters which are available at present are insufficient for giving a

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SOV/57-28-10-7/40

Investigation of the Spectral Distribution of the Photoconductivity of CdS  
Single-Crystals at 77 and 20°K

unique answer to the question how such a relation should be established. In this paper only a few possibilities can be mentioned. A careful confrontation of the spectral distribution of the steady photocurrent with the absorption spectra showed the absence of any immediate connection between photoconductivity and the narrow absorption lines. V. Ye. Iashkarev, Member, Academy of Sciences, UkrSSR, and A. F. Prikhod'ko, Corresponding Member of the Academy of Sciences, UkrSSR, showed constant interest in this work. E. I. Rashba discussed the work with the authors. There are 5 figures, 2 tables, and 28 references, 16 of which are Soviet.

SUBMITTED: December 16, 1957

Card 3/3

24(6)

AUTHORS:

Broude, V.L., Yeremenko, V.V.,  
Medvedev, V.S.

SOV/57-23-10-26/40

TITLE:

Spectra of Photoconductivity Excitation and of Luminescence of CdS Crystals (Spektry возбужdeniya fotoprovodimosti i lyumines-tsentsii kristallov CdS)

PERIODICAL:

Zhurnal tekhnicheskoy fiziki, Vol 28, Nr 10, pp 2263-2265 (USSR), 1978

ABSTRACT:

In order to analyze the relation between the photoconductivity and the luminescence of CdS crystals a joint investigation of the spectra of photoconductivity excitation and of luminescence at 20°K was carried out. According to the experience gained the crystal samples could be categorized as follows: 1) First group: The diagrams obtained showed an approximative coincidence of the maxima of the curves describing the spectral distribution of photoconductivity and of the spectra of green luminescence. 2) Second group: The two spectra mentioned exhibit a pronounced divergence. 3) Third group: This group is distinguished by an intense orange luminescence. The information collected leads to the following conclusions: 1) The photoconductivity of CdS crystals and the green luminescence are closely related. The excitation spectra of some samples coincide. 2) A divergence between the

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Spectra of Photoconductivity Excitation and of  
Luminescence of CdS Crystals

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spectral distribution of photoconductivity and the curve describing the dependence of the intensity of green luminescence upon the wavelength of the exciting light (group 2) is, as a rule, observed, if a sharp decline of photosensitivity occurs towards smaller wavelengths. 3) On the strength of the fact that the two curves in question do not agree with each other, the conclusion is drawn that the absorption of CdS crystals is, at least in the range of  $20\ 600 - 20\ 800\ \text{cm}^{-1}$ , of a mixed nature (Ref 3). A similar conclusion can also be drawn for the crystals of the first group. These samples yielded curves with coinciding peaks of the excitation and of the absorption. 4) Two kinds of excitation of the orange luminescence were discovered. This apparently indicates that two different kinds of luminescence are in existence in this range. Some crystals exhibit an orange luminescence accompanied by a green luminescence, causing an absorption in the range of  $20\ 600 - 20\ 700\ \text{cm}^{-1}$ . A more detailed analysis of the results will be presented in another paper. There are 2 figures and 3 references, 3 of which are Soviet.

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Spectra of Photoconductivity Excitation and of  
Luminescence of CdS Crystals

SOV/57-29-10-26/40

SUBMITTED: May 8, 1958

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AUTHORS: Broude, V. L., Yeremenko, V. V., 20-119-5-19/59  
Chikovani, N. N.

TITLE: The Structure of the Absorption and the  
Photoelectric Conductivity Spectra of CdS Crystals  
at 20°K (Struktura spektrov pogloshcheniya i  
fotoprovodimosti kristallov CdS pri 20°K)

PERIODICAL: Doklady Akademii Nauk SSSR, 1958, Vol. 119, Nr 5,  
pp. 911-913 (USSR)

ABSTRACT: It was of interest to measure the coefficients of  
absorption of light by CdS crystals within the short  
wave range, as well as to estimate the changes of band  
intensities connected with the distortions of the lattice.  
In order to determine the nature of photoproduction, a  
comparison of the spectral distribution of the absorption  
coefficient with the spectral distribution of a steady  
photoelectric current was of importance. The investigation  
was carried out at 20°K and used a metal cryostat with

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The Structure of the Absorption and the  
Photoelectric Conductivity Spectra of CdS Crystals  
at 20°K

20-119-5-19/59

plane windows in which the sample was cooled by vapors of boiling hydrogen. The photoconductivity was measured in a glass monochromator with lengthened chamber ( $F = 1$  m) produced by Messrs. Leitz. The absorption coefficient was measured by photographic photometric measurement using a nine-stage attenuator. The authors succeeded in carrying out the measurement of the absorption curve up to a frequency of  $20860 \text{ cm}^{-1}$  in the polarization of light along the c-axis, and up to a frequency of  $20680 \text{ cm}^{-1}$  in the strong component of the spectrum. A diagram shows the curves of spectral distribution of the absorption coefficient for polarized light parallel and vertical to the optical axis of the CdS crystal at 20°K. Starting with the frequency of  $20625 \text{ cm}^{-1}$  the light is almost completely absorbed in a crystal of the thickness  $15 - 20 \mu$ . The absorption of the light within the range of frequencies above  $20600 \text{ cm}^{-1}$  is sufficiently stable in various samples.

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The Structure of the Absorption and the  
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Within the range of long-wave narrow-band absorption the absorption coefficient in band 10 changes a dozen times. Within the range of strong absorption the authors could not determine the curve  $\alpha(\lambda)$ , as they did not dispose of sufficiently thin crystals. They compared, however, the obtained absorption curves with the spectra of thin crystals existing in references and they could conclude the following: In the polarization of light along the optical axis of the crystal the first peak of photoproduction corresponds to the increase of the absorption coefficient in that range of the spectrum where the absorption does not change from sample to sample. The further increase of  $\alpha$  leads to a decrease of the photoelectric current. Also the second peak of the photoelectric current is located on the rising branch of the absorption curve. The first maximum of the photoelectric current is located within the range of the lines 4 - 10, and the

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The Structure of the Absorption and the  
Photoelectric Conductivity Spectra of CdS Crystals  
at 20°K

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second maximum within the range of band 13. There are no changes whatever for the c-component on the curve of photoconductivity within the range of band 10. By proposal of E. I. Rashba the values of the steady photoelectric current at various wavelengths were compared with one another; the results of this comparison are mentioned in a table. There is no clear coincidence between the steady photoelectric current and the absorption coefficient of light. This speaks in favor of the fact that the dependence of photoconductivity on the absorption coefficient is complicated by the explicit dependence of the photoelectric current on the wave length of the absorbed light. Finally the author thanks A. F. Prikhod'ko and E. I. Rashba for their active participation in the discussion of this work. There are 2 figures, 1 table, and 4 references, 4 of which are Soviet.

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The Structure of the Absorption and the  
Photoelectric Conductivity Spectra of CdS Crystals  
at 20°K

20-119-5-19/59

ASSOCIATION: Institut fiziki Akademii nauk USSR (Institute of  
Physics, AS Ukrainian SSR)

PRESENTED: December 6, 1957, by A. N. Terenin, Member, Academy of  
Sciences, USSR

SUBMITTED: December 4, 1957

Card 5/5

22.120

35315  
S/058/62/000/005/046/119  
A001/A101

AUTHORS: Broude, V. L., Yeremenko, V. V., Rashba, E. I.

TITLE: Impurity absorption and luminescence in CdS single crystals

PERIODICAL: Referativnyy zhurnal, Fizika, no. 5, 1962, 33, abstract 5V225  
(V sb. "Fotoelektr. i optich. yavleniya v poluprovodnikakh",  
Kiyev. AN USSR, 1959, 43-52)

TEXT: On the basis of studying absorption spectra of CdS crystals, the impurity origin of absorption in the region of narrow lines ( $20,400 - 206,000 \text{ cm}^{-1}$ ) was shown; these lines are due to electron transitions in the CdS lattice near its dislocations. Blue luminescence of CdS is caused by light emission from the same absorption centers, to which pertain absorption lines  $20,440$ ;  $20,525$ ;  $20,575$  and  $\sim 20,600 \text{ cm}^{-1}$ . A hypothesis is put forth on the existence of six types of defects.

[Abstracter's note: Complete translation]

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SOV/120-59-1-28/50

AUTHORS: Babenko, V. P., Broude, V. L., Medvedev, V. S., Prikhot'ko, A. F.

TITLE: Methods and Apparatus for Low Temperature Optical and Spectral Studies (Metody i apparatura nizkotemperaturnykh opticheskikh i spektral'nykh issledovaniy)

PERIODICAL: Pribery i tekhnika eksperimenta, 1959, Nr 1, pp 115-120 (USSR)

ABSTRACT: Metallic cryostats for optical and spectral studies at liquid hydrogen and liquid helium temperatures have been developed by the present authors and are briefly described in this paper. The cryostats are designed for work on the absorption and luminescence of crystals in free and stressed state as well as for photoelectric low temperature studies. Figs 2 and 3 show the hydrogen and helium cryostats respectively. The cryostat shown in Fig 2 loses 1 litre of hydrogen in 18-20 hours. The cryostat shown in Fig 3 loses 1 litre of hydrogen in 30 hours or 1 litre of helium in 5 hours. Various attachments and specimen holders used in conjunction with these cryostats are shown in Figs 4-7. One of the features of the cryostats is their vacuum sealed windows of the type shown in Fig 1. The present cryostats are modified forms of the cryostats described by the present authors in Refs 6 and 7.

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SOV/120-59-1-28/50

Methods and Apparatus for Low Temperature Optical and Spectral Studies.

There are 7 figures and 8 references, of which 4 are Soviet, 1 is French and the rest are English.

ASSOCIATION: Institut fiziki AN USSR (Institute of Physics of the Academy of Sciences of the USSR)

SUBMITTED: January 3, 1958

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24(2)

AUTHORS:

Broude, V. L. Prikhod'ko, A. F.,  
Rashba, E. I.

SOV/53-67-1-5/12

TITLE:

Some Problems of the Luminescence of Crystals (Nekotoryye  
voprosy lyuminesentsii kristallov)

PERIODICAL:

Uspekhi fizicheskikh nauk, 1959, Vol 67, Nr 1, pp 99-117 (USSR)

ABSTRACT:

The authors make a contribution to the research of non-equilibrium states of nonmetallic crystals by the publication of a carefully compiled survey of the research results concerning crystal luminescence, devoting special attention to the exciton mechanism (Ya. I. Frenkel')(Ref 1). The latter was found to be very suited for describing excited states of crystals, in which there is no photoconductivity. Problems like the excitation and extinction of luminescence are not dealt with because they and others have been discussed by L. V. Levshin (Ref 6) in a survey. The entire experimental material confirms that in the case of excitation within the range of eigenabsorption the luminescence spectrum does not depend on the wavelength of the exciting light. The article first gives a short survey of the luminescence of pure crystals, i.e. of such without structural defects and

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## Some Problems of the Luminescence of Crystals

SOV/53-67-1-5/12

impurities. Table 1 gives data ( $\nu$ ,  $\lambda$ ) for benzene, naphthalene, anthracene, naphthacene, hexamethyl benzene, hexaethyl benzene, and  $\psi$ -iso-cyanine for the longest-wave intensive bands of eigenabsorption (Refs 11-17). A more detailed account is given of the luminescence phenomena on crystals containing impurities. Among others, the investigations carried out by V. Ye. Lashkarev and Yu. M. Karkhanin (Refs 33,42) on semiconductor crystals ( $\text{Cu}_2\text{O}$ ) concerning excitation as a result of energy transfer by electron-hole pairs are discussed, and numerous data are given in a table concerning spectra of impurity crystals. The data were obtained from publications by A. F. Prikhod'ko, M. T. Shpak, E. V. Shpol'skiy, L. A. Klimova, E. A. Girdzhiyanskaya and A. V. Solov'yev.

The next chapter contains data on the luminescence of crystals at low temperatures. Numerous crystals have particularly bright luminescence at low temperatures, which was in most cases found to be due to impurities. However, also so-called "pure" crystals (V. A. Arkhangel'skaya, P. P. Feofilov, Ref 56) occasionally show bright luminescence and have certain characteristic features in their spectra. The first investigations of molecule crystals at low temperatures were carried out

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Some Problems of the Luminescence of Crystals

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by I. V. Obreimov, A. F. Prikhod'ko, and K. Shaballas (Ref 57) (anthracene, 20° K); figure 2 shows this absorption- and luminescence spectrum, which was recorded by A. F. Prikhod'ko and I. Ya. Fugol' (Ref 65). Figure 1 in a similar manner shows the absorption line spectrum and the "blue" luminescence spectrum of one and the same CdS crystal at 20° K. A large number of molecule- and semiconductor crystals has already been investigated at low temperatures; the results obtained by these investigations are discussed in short. Finally, the quasiequilibrium distribution in the excited state is discussed which was investigated on the basis of the example of the optical and photoelectric properties of CdS crystals by numerous authors (Rashba, Broude, Yeremenko, N. N. Chikovani etc.) There are 2 figures, 2 tables, and 75 references, 53 of which are Soviet.

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~~24 (5), 24 (7)~~ 24.3500

66449

SOV/20-129-3-16/70

AUTHORS:

Broude, V. L., Medvedev, V. S.

TITLE:

On a New Possibility of Explaining the Dependence of the Luminescence Quantum Yield on the Excitation Wavelength

PERIODICAL:

Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 3, pp 533-535 (USSR)

ABSTRACT:

The authors investigated the spectra of the excitation of solid anthracene solutions, the luminescence of which had been excited within the absorption range of anthracene. Styrene, which is transparent in the range of anthracene absorption, was used as a solvent. Two types of samples were produced. In the first case, the spectrum of the excitation of the luminescence of an anthracene solution was investigated in liquid styrene, after which the pumped-out ampule with the solution was put into a thermostat for polymerization. In the second case, polymerization of pure styrene was carried out under the same conditions, but anthracene was weighed-in into the ready polystyrene, which was heated until it was completely softened. The curves of the first diagram practically show the dependence of the luminescence quantum yield on the excitation wavelength. In this case the curves of

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the spectral distribution of the luminescence quantum yield for anthracene (dissolved in liquid styrene) for the same solution after polymerization and for the anthracene solution in the ready polystyrene is concerned here. These curves are indicative of the approximated constancy of the quantum yield for the entire investigated range of the spectrum, and a sharp decline is found only on the long wave edge. Luminescence excitation spectra of the solid polymerized anthracene solution in styrene have a sharply marked structure, which corresponds to the oscillation of the luminescence yield as a function of wave length excitation. In this case there is an anticorrelation between the luminescence quantum yield and the absorption coefficient within the individual bands. The structure found here in the luminescence quantum yield is connected neither with the non-active absorption of an uncontrollable impurity nor with the reabsorption of the luminescence light. The results obtained in the present paper indicate the following: In common polymerization the anthracene molecules in some way penetrate into the polystyrene chain. This is confirmed by special

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experiments carried out by the authors. The character of the penetration just mentioned is, as yet, not clear. The structure of the quantum yield curve of luminescence can be explained not only according to the usual hypothesis of exciton migration to the surface of the crystal, but also by conceptions on special interactions between the molecule and the surrounding medium. The authors thank I. P. Dmitrenko for assisting in carrying out the chemical part of this investigation, and also A. F. Prihot'ko and V. M. Buymistrov for taking part in the discussion of the present paper. There are 1 figure and 8 references, 4 of which are Soviet.

ASSOCIATION: Institut fiziki Akademii nauk USSR (Institute of Physics of the Academy of Sciences of the UkrSSR)

PRESENTED: May 25, 1959, by I. V. Obreimov, Academician

SUBMITTED: May 18, 1959  
Card 3/3

82947

S/051/60/008/005/006/027  
E201/E491

5.3100

AUTHORS: Broude, V.L. and Onopriyenko, M.I.TITLE: Absorption Spectra of Benzene Homologues.  
IV. Characteristics of the Spectra of Crystals

PERIODICAL: Optika i spektroskopiya, 1960, Vol.8, No.5, pp.629-634

TEXT: Detailed investigations of the absorption spectra of benzene homologues at low temperatures (Ref.1 to 4) yield information on general properties on the spectra of crystals of these compounds. The present paper is an analysis of the experimental data on the exciton splitting of crystalline absorption bands, the profile and width of absorption bands and the sensitivity of crystalline spectra to small changes in the crystal structure. Fig 1. shows the splitting and polarization of absorption bands in the purely electronic transition region in the spectra of benzene/crystals (1) and its methyl derivatives: high temperature modification of toluene (2); m-xylene (3); mesitylene (4); durene (5); low-temperature modification of hexamethylbenzene (6). The clearest exciton effects were observed in the absorption spectra of crystals whose molecules have a forbidden purely electronic transition in their free state. This

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S/051/60/008/005/006/027  
E201/E491

Absorption Spectra of Benzene Homologues. IV. Characteristics of the Spectra of Crystals

contradicts Davydov's theory, who predicted that the exciton splitting of the transitions forbidden in a free molecule should be considerably smaller than in the transitions allowed in a free molecule. E.I. Rashba suggested that agreement between theory and experiment could be improved by allowing for the effect of an interaction between electron excitation and the lattice vibrations on the magnitude of the exciton splitting (Ref.7). The strong polarization of the absorption bands (Fig.1) does not, by itself, indicate exciton origin. Polarization effects may be due to mechanical deformation of the crystal. This is illustrated for benzene crystals in Fig.2, which shows that deformation increases separation of the  $38351\text{--}38360\text{ cm}^{-1}$  doublet and weakens the short-wavelength component. Symmetry of the free benzene molecule is close to  $D_{6h}$ . In crystals the benzene symmetry is represented by the  $C_i$  point group. The difference between the interatomic separations of the free and crystalline state amounts to  $0.005\text{ \AA}$  which is equivalent to  $0.4\%$ ; the difference in angles amounts to

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E201/E491

Absorption Spectra of Benzene Homologues. IV. Characteristics of the Spectra of Crystals

1°14' or 0.8%. Non-coplanarity of the atoms is due to their displacement from the plane of the ring by 0.0013 Å (Fig.3). These small changes in the structure of the molecule are quite sufficient to alter the purely electronic transition from the forbidden status in a free molecule to the allowed status in a crystal, i.e. very small changes of molecular structure produce a noticeable effect in the absorption spectra. The authors discuss also qualitatively the profiles of the absorption bands of crystals and conclude the paper with acknowledgments to A.F.Prikhot'ko and E.I.Rashba for their advice. There are 3 figures, 1 table and 10 references: 9 Soviet and 1 English.

SUBMITTED: September 15, 1959

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50180  
S/051/60/008/06/011/024  
E201/E691

5.3100

## AUTHORS:

Broude, V.L. and Onopriyenko, M.I.

## TITLE:

The Absorption Spectra of Benzene Homologues. V. The Spectra of Toluene Crystals at 20°K

PERIODICAL: Optika i spektroskopiya, 1960, Vol 8, Nr 6, pp 815-823 (USSR)

## ABSTRACT:

The absorption spectra of amorphous and crystalline toluene were obtained at 20°K and interpreted. The physical constants of 99.6% pure toluene used by the authors were: melting point of -95.00°C, boiling point of 110°C,  $d_4^{20} = 0.86694$ ,  $n_D^{20} = 1.4970$ . Toluene was prepared and purified in the laboratory of A.L. Liberman (Institute of Organic Chemistry, Ac. Sc. USSR). The spectra of monocrystals in polarized light were obtained by means of a spectrograph ISP-22. The samples were prepared and cooled in a special metal cryostat (Ref 3). The results are shown in Figs 1-4 and their interpretation is given in a table on pp 820-822. Comparison of the toluene and benzene spectra showed that the aromatic C--C bonds in toluene are not all equivalent. It was also found that the broadening and the diffuse nature of the bands of the low-temperature modification of toluene (Ref 2) are due to imperfections of these

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30550

S/051/60/008/06/011/024  
E201/E691

The Absorption Spectra of Benzene Homologues. V. The Spectra of Toluene Crystals  
at 20°K

crystals and their mechanical deformation during cooling. There  
are 4 figures, 1 table and 8 references, 5 of which are Soviet and  
3 English. X

SUBMITTED: October 21, 1959

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BROUDE, V.L.; MEDVEDEV, V.S.

Luminescence of solid solutions of anthracene. Izv. AN SSSR. Ser.  
fiz. 24 no. 5 549-552 My '60. (MIRA 13:5)

1. Institut fiziki AN USSR.  
(Anthracene--Optical properties)



25680

S/181/61/003/007/002/023

B102/B202

24.7400 (1160, 1395, 1142)

AUTHORS: Broude, V. L. and Rashba, E. I.

TITLE: Exciton absorption in mixed molecular crystals

PERIODICAL: Fizika tverdogo tela, v. 3, no. 7, 1961, 1941 - 1949

TEXT: The authors attempted to develop a simplified theory of the excitonic light absorption in molecular mixed crystals. In previous papers the authors had developed a theory of the impurity absorption of light in molecular crystals for the case that the impurity absorption band lies near the region of exciton absorption of the solvent crystal. They also studied experimentally the absorption spectra of crystalline solutions of the deuterio-substitutes of benzene. The results of these studies are utilized in this paper. The authors consider a crystalline substitution solution. They assume molecules of different kinds to be present in a fixed position in the lattice sites.  $i$  denotes the kind,  $n$  counts the unit cells, and  $\alpha$  the molecules therein,  $N$  is the number of cells in the crystal. The authors confine themselves to solutions of molecules in which one or several atoms are substituted by isotopes; in

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Exciton absorption ...

this case it can be assumed approximately that the integrals of resonant interaction between the molecules  $M_{n\alpha, m\beta}$  are independent of the isotopic composition;  $\epsilon_{n\alpha}^0$  denotes the excitation energy of the molecules  $n\alpha$ ,  $D_{n\alpha, m\beta}$  the change of the excitation energy of a  $n\alpha$  molecule on its incorporation into the crystal caused by interaction with a  $m\beta$  molecule. With these designations the excitation amplitudes  $a_{n\alpha}$  of the molecules are determined by minimizing the energy functional

$$E = \sum_{n\alpha} (\epsilon_{n\alpha}^0 + \sum_{m\beta} D_{n\alpha, m\beta}) |a_{n\alpha}|^2 + \sum_{\substack{n\alpha, m\beta \\ n\alpha \neq m\beta}} \hat{a}_{n\alpha} M_{n\alpha, m\beta} \hat{a}_{m\beta} \quad (1)$$

and by satisfying the normalization condition  $\sum_{n\alpha} |a_{n\alpha}|^2 = 1$ . For a one-component system (1) passes into the corresponding formula by A. S. Davydov.  $a_{i\alpha}$  is then introduced as the new excitation amplitude;  $a_{n\alpha} = N^{-1/2} a_{i\alpha}$ , which is an approximation substantiated by experimental facts. Thus,

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$$E = \sum_i f_i \left[ \epsilon_i^0 + \sum_j D_{ij} f_j \right] |a_{i\alpha}|^2 + \sum_{i,j,\alpha} \dot{a}_{i\alpha} f_i M_{ij} f_j a_{j\alpha} \quad (2)$$

is obtained where  $f_i$  is the relative concentration of the components ( $\sum_i f_i = 1$ ), with the normalization condition  $\sum_{i\alpha} f_i |a_{i\alpha}|^2 = 1$ . Here

$M_{\alpha\beta} = \sum_{\underline{m}} M_{\underline{m}\alpha, \underline{m}\beta}$  and  $D_{ij} = \sum_{\underline{m}} D_{\underline{m}i, \underline{m}j}$ , if all  $\underline{m}\alpha$  sites contain molecules of the kind  $i$ , all others such of the kind  $j$ . The system of equations

$$(\epsilon_i - E) a_{i\alpha} + \sum_{j\beta} M_{ij} f_j a_{j\beta} = 0, \quad (3)$$

$$\epsilon_i = \epsilon_i^0 + \sum_j D_{ij} f_j = \epsilon_i[f_j].$$

is derived therefrom.  $(\epsilon_i - E) a_{i\alpha}^\tau = b_{\alpha}^\tau$ , follows from (3) and from the orthogonality condition, i. e., the excitation amplitude in molecules of different kinds is inversely proportional to the distance of their terms

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Exciton absorption ...

from the absorption band ( $\tau$  numbers the eigenvectors of the system (3)). Thus, the order of (3) can be reduced to an order which is equal to the number  $\sigma$  of the molecules in a unit cell:  $\sum_{\beta} M_{\alpha\beta} b_{\beta} = \epsilon b_{\alpha}; \frac{1}{\epsilon} = \sum_j f_j / (E - \epsilon_j);$

this system is equal to an analogous system in the theory of pure crystals, but with the difference that the transition energy is equal to  $E$ .

$$G_1^2 = \frac{1}{\epsilon^2} \frac{\left| \sum_{\alpha} B_{\alpha}^2 p_{\alpha} \right|^2}{\sum_j \frac{f_j}{(\epsilon_j - E)^2}} \quad (13)$$

is found for the transition probability under the action of light (whose electrical vector is polarized along  $\vec{1}$ ) by using the square of the matrix element of the component of the dipole moment of the transition along  $\vec{1}$ , as referred to the unit cell. The following relations are also given:  $\sum_{\alpha} \epsilon_{\alpha} = \epsilon_s + \sum_i \epsilon_i$  and  $\frac{1}{\epsilon_s} = \sum_j \frac{f_j}{\epsilon_{\alpha} - \epsilon_j}$  (15). Function

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Exciton absorption ...

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$$F\left(\frac{E}{\epsilon}\right) = \frac{\left[\frac{f_1}{E+\epsilon} + \frac{f_2}{E-\epsilon}\right]^2}{\frac{f_1}{(E+\epsilon)^2} + \frac{f_2}{(E-\epsilon)^2}} \quad (16)$$

can be used in the form of

$$F\left(\frac{E}{\epsilon}\right) = \frac{\left(\frac{E-E_{\min}}{\epsilon}\right)^2}{[1-(f_1-f_2)^2] + \left(\frac{E-E_{\min}}{\epsilon}\right)^2} \quad (17)$$

if  $E_{\min} = \epsilon(f_1 - f_2)$ ;  $(\epsilon = (\epsilon_1 - \epsilon_2)/2)$ . The theoretical results are then compared with the experimental ones under simpler assumptions. Using formulas (13) and (15), the authors found the results shown in Tables 1 and 2 (which are compared with those of Ref. 6) assuming that the concentration of the  $i$ -th component tends to zero and the frequency of the bands corresponding to it goes to  $\epsilon_i$ , and that  $D_{ij}$  is a linear function

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S/181/61/003/007/002/023  
B102/B202

Exciton absorption ...

of the deuteron atoms in the j-molecules. Ref. 6: C. K. Ingold et al: J. Chem. Soc. (L.), 971, 1936; C. K. Ingold et al. J. Chem. Soc. (L.), 406, 1948. There are 2 figures, 2 tables, and 6 references: 5 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Institut fiziki AN USSR (Institute of Physics of the AS UkrSSR) *Grande*  
Institut poluprovodnikov AN USSR Kiyev (Institute of Semiconductors AS UkrSSR, Kiyev) *Rashba*

SUBMITTED: January 4, 1960

Card 6/8

34428  
S/185/61/006/006/005/030  
D299/D304

26.2420

AUTHORS:

Broude, V.L., and Chykovani, N.M.

TITLE:

Spectral distribution of photoconductivity in CdS single crystals at 300, 77 and 20°K

PERIODICAL: Ukrayins'kyy fizychnyy zhurnal, v. 6, no. 6, 1961, 750

TEXT: It is pointed out that the complete article will appear in the Ukr. Fiz. Zh., v. 7, no. 2, 1962. An interpretation is proposed of the basic features of photoconductivity spectra of CdS single crystals, based on the assumption that the single crystals have mixed absorption in the spectral region under consideration. The interaction between light and the single crystals is accompanied by the appearance of two different excitation-states; no quasi-equilibrium distribution is established between these states during their lifetime. Both types of absorption are accompanied by the creation of carriers. The relationship between the two absorption types differs with spectral wavelength; hence the efficiency of carrier crea-

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Spectral distribution of ...

S/185/61/006/006/005/030  
D299/D304

tion as a result of light absorption (of the two types), varies  
greatly with temperature. [Abstractor's note: Complete translation].

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X



BROUDE, V.L.; ONOPRIYENKO, M.I.

Absorption spectra of crystals of ordinary and deuterated benzene  
at 20°K. Opt.i spektr. 10 no.5:634-639 My '61. (MIRA 14:8)  
(Benzene crystals--Spectra)

BROUDE, V. L.; PRIHOTKO, A. F. [Prihot'ko, A. F.]; RASBA, E. I. [Rashba, Ye.I.]

Some problems of crystal luminiscence. Tr. from the Russian. Analele  
mat 15 no.4:85-104 O-D '61.

(Crystals) (Luminiscence)

20855

S/048/61/025/003/045/047  
B:04/B203

24.3500 (1137, 1147, 1395)

AUTHORS: Broude, V. L. and Medvedev, V. S.

TITLE: Dependence of the yield in "blue" luminescence of cadmium sulfide crystals at 20°K on the excitation wavelength

PERIODICAL: Izvestiya Akademii nauk SSSR. Seriya fizicheskaya, v. 25, no. 3, 1961, 430-433

TEXT: This paper was read at the 9th Conference on Luminescence (Crystal Phosphors) in Kiyev, June 20-25, 1960. In the experiments described, luminescence was excited by a diffraction monochromator with a dispersion of 3 Å/mm. Fig. 1 shows the spectral dependence of the yield in green (Curve 1), red (Curve 2), and blue (Curve 3) luminescence of one of the specimens. The authors conclude from the results that in the CdS crystals investigated an increase in intensity of blue luminescence due to a change in wavelength of the exciting light is accompanied by a drop in intensity of luminescence in the other spectral ranges. A particularly distinct dependence of the intensity of blue luminescence on the absorption coefficient of the CdS crystals was found; the authors utilized this

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S/048/61/025/003/045/047  
B104/B203

Dependence of the yield in...

circumstance to determine the absorption curve in the shortwave range. The absorption spectrum (shown in Fig. 2) of this crystal can be divided into three parts. Very narrow absorption bands with a polarization perpendicular to the  $\vec{c}$ -axis of the crystal lie in the range between 20400 and 20560  $\text{cm}^{-1}$ . A little wider, intense absorption bands lie in the range between 20560 and 20780  $\text{cm}^{-1}$ , and wide absorption bands in the range of up to 23000  $\text{cm}^{-1}$ . In the second range, the polarizations of absorption bands are different, in the third range, they are poorly distinct (Fig. 2). Detailed data are given in Table 1. A change in intensity of absorption bands due to mechanical stresses in the crystal is also pointed out. In a discussion of these results, the similarity of absorption spectra with those of molecular crystals is mentioned; at the same time, it is stated that the CdS crystal takes an intermediate position between ion crystal and molecular crystal. There are 3 figures, 1 table, and 7 Soviet-bloc references.

ASSOCIATION: Institut fiziki Akademii nauk USSR (Institute of Physics of the Academy of Sciences UkrSSR)

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Dependence of the yield in...

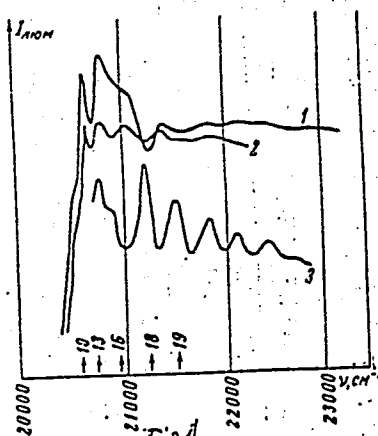


Fig. 1

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B104/B203

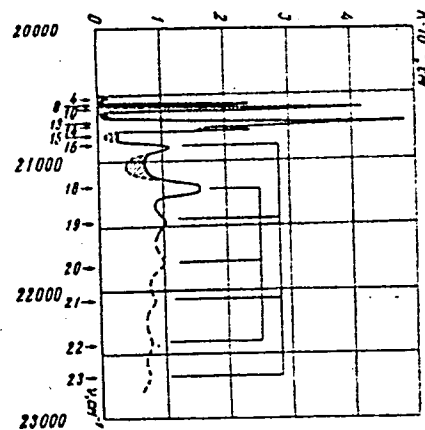


Fig. 2

Dependence of the yield in...

Legend to Table 1:  
 (1) No. of specimen,  
 (2) maximum frequency  
 in  $\text{cm}^{-1}$ , (3) absorption  
 coefficient in the  
 maximum.  $\text{cm}^{-1}$ . (4)  
 polarization.

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№ полосы	Частота максимума, см <sup>-1</sup>	Коэффициент погло- щения в максимуме, см <sup>-1</sup>	Поларизация	
1	20400+20415	0+10 <sup>3</sup>	} ⊥ c	
2	20430+20450	0+10 <sup>3</sup>		
3	20500	0+10 <sup>3</sup>		
4	20513+20525	10 <sup>3</sup> +10 <sup>3</sup>		
5	20530	0+10 <sup>3</sup>	} ⊥ c	
6	20545	0+10 <sup>3</sup>		
7	20550	0+10 <sup>3</sup>		
8	20572	10 <sup>3</sup> +2·10 <sup>3</sup>		
9	20580	0+10 <sup>3</sup>	} ⊥ c ≪ ∥ c	
10	20585+20600 {	4·10 <sup>3</sup> (⊥ c) 10 <sup>3</sup> +10 <sup>3</sup> (∥ c)		
11	20625	~10 <sup>3</sup>		} ∥ c > ⊥ c
12	20685	~10 <sup>3</sup>		
13	20700	~5·10 <sup>3</sup>		
14a	20740	} ~2·10 <sup>3</sup>	} ⊥ c ≈ ∥ c ⊥ c > ∥ c ⊥ c > ∥ c ⊥ c > ∥ c	
14b	20750			
15	20800			
16	20875	~3·10 <sup>4</sup>		
17	20930	~10 <sup>3</sup>	} ∥ c > ⊥ c	
18	21190	~7·10 <sup>4</sup>		
19	21458	~1,5·10 <sup>3</sup>		
20	21788	} ~10 <sup>3</sup>		
21	22060			
22	22415			
23	22670			

BROUDE, V.L.

Spectral investigations of benzene. *Usp. fiz. nauk* 74  
no.4:577-608 Ag '61. (MIRA 14:8)  
(Benzene—Spectra)

24 4400 1158 1395 also 1160 1482

27257  
S/020/61/139/005/007/021  
B104/B201

AUTHORS: Broude, V. L., Rashba, E. I., and Sheka, Ye. F.

TITLE: Anomalous impurity absorption near exciton bands of molecular crystals

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 139, no. 5, 1961, 1085-1088

TEXT: If, in a molecular crystal, the distance  $\ell$  of an impurity level from the edge of the exciton band is smaller than, or is of the same order of magnitude of the width  $M$  of the exciton band, an absorption of light within the range of the impurity band will lead to the formation of quantum states, in which not only the impurity molecule, but also the adjoining molecule of the solvent will be excited. For  $\ell \ll M$ , the dimensions of the regions in which the excitation is concentrated, are larger than the lattice constant. The structure of the exciton band near its edge displays an influence upon the characteristics of impurity absorption. If, in this case, the impurity molecule does not differ from a molecule of the solvent except by a shift of energy levels,

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Anomalous impurity absorption near ...

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S/02C/61/139/005/007/021  
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impurity absorption will diminish as  $\xi^{1/2}$  if an optical transition to the edge of the exciton band with a given polarization of light is forbidden, or will grow as  $\xi^{-3/2}$  if such a transition is allowed. Thus, the coefficients of these relations are sharply dependent upon  $\xi$ , and so are the polarization relations; for  $\xi \ll \xi_M$ ,  $\xi$  itself is a function of the distance  $2f$  between the levels of the molecule of the solvent and the impurity molecules. Thus, the characteristics of impurity absorption permit conclusions to be drawn regarding the structure of exciton bands. Objects suited for these investigations are molecular crystals, in which the molecules of the solvent do not differ from the impurity molecules except by their isotopic composition. Solutions of ordinary naphthalene ( $C_{10}H_8$ ) in octadeuteronaphthalene ( $C_{10}D_8$ ) and in tetradeuteronaphthalene ( $\alpha-C_{10}D_4H_4$  and  $\beta-C_{10}D_4H_4$ ) have been studied. These preparations were supplied to the authors by Professor A. I. Shatenshteyn, and had been prepared in his laboratory at the Institut fizicheskoy khimii im. L. A. Karpova (Institute of Physical Chemistry imeni L. A. Karpov). The naphthalene concentration amounted to some percents. The effects observed are in agreement with those theoretically predicted by E. I. Rashba

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Anomalous impurity absorption near ...

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S/020/61/139/005/007/021  
B104/B201

(Optika i spektroskopiya, 2, 568 (1957); Dokl. na X soveshch. po spektroskopii, L'vov, iyul' 1956., Fiz. sborn. L'vovsk gos. univ., v. 3, 1, 140, 1957). A close examination of the spectra revealed that whenever an anomaly appeared in the intensity of the impurity bands, also the interval between the impurity absorption bands varied at the same time. It is inferred that the A-component of the Davidov doublet corresponds to a transition to the bottom of the A-band of the crystal. This allows the conclusion to be drawn on the strength of a well-known selection rule that the point  $\vec{k} = 0$  lies on the bottom of the A-band, and the effective mass of the exciton in this range is positive. There are 2 figures, 2 tables, and 9 references: 8 Soviet and 1 non-Soviet. The reference to English-language publications reads as follows: D. S. McClure, J. Chem. Phys., 24, 1668 (1954).

ASSOCIATION: Institut fiziki Akademii nauk USSR (Institute of Physics, Academy of Sciences UkrSSR)  
Institut poluprovodnikov Akademii nauk USSR (Institute of Semiconductors, Academy of Sciences UkrSSR)

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44158

S/181/62/004/010/055/063  
B102/B104

9.25.76 (also 4205)

AUTHORS: Broude, V. L., Mashkevich, V. S., Prihot'ko, A. F.,  
Prokopyuk, N. F. and Soskin, M. S.

TITLE: Possibility of obtaining induced radiation in systems with  
electron vibrational levels

PERIODICAL: Fizika tverdogo tela, v. 4, no. 10, 1962, 2976-2978

TEXT: A possibility of obtaining negative temperatures and induced radiation in a four-level scheme of molecular systems is discussed. The scheme (Figure) consists of the ground state (1), a vibrational level of the electron ground state (2), the first excited electron level (3), and the totality of all higher levels (4). 1-4 is a transition due to light-quantum absorption, 4-3 a radiationless transition, 3-2 the transition used for obtaining the induced radiation and 2-1 again a radiationless transition. The lifetimes of the radiative transitions are  $\tau_r \sim 10^{-7} - 10^{-9}$  sec, those of the radiationless transitions are  $\tau_n \ll \tau_r$ .  $\tau_n$  has to be small for obtaining the induced radiation. Generation of

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Possibility of obtaining induced ...

coherent induced radiation begins if  $n_3 - n_2 \geq 8\pi^2 \tilde{\nu}^2 \Delta \tilde{\nu} \tau_0 \frac{1-R}{l}$  where  $n_2, n_3$  are the mean numbers of molecules in state 2 or 3 per unit volume,  $\tilde{\nu}$  is the wave number of the 3-2 transition,  $\Delta \tilde{\nu}$  the halfwidth,  $R$  the reflection coefficient of the resonator mirror,  $l$  is the length of the sample, and  $\tau_0$  is the lifetime of state 3 with respect to the 3-2 transition.

$n_3 \approx 4\pi K \eta N$ , where  $\tau$  is the lifetime of state 3 with respect to all other transitions to lower states,  $K$  is the mean absorption coefficient on the region of the 1-4 transition,  $\eta$  is the number of states 3 produced from one state 4, and  $N$  is the number of photons of the optical excitation 1-4 per unit of time and per unit of surface area. Numerical estimates

for the anthracene molecule are presented. For  $K=2 \text{ cm}^{-1}$ ,  $\eta = 1$ ,  $\tau = 3 \cdot 10^{-8} \text{ sec}$  and  $\tau_0 = 10^{-7} \text{ sec}$  one obtains  $N = 4 \cdot 10^{21} \text{ cm}^{-2} \text{ sec}^{-1}$  which can

be realized by means of an ИФК-2000 (IFK-2000) pulsed lamp. If besides  $\tau_n \ll \tau_r$ ,  $n_2 \ll n_3$ ,  $N$  will depend on  $\tau_0/\tau$ , not on  $\tau$  alone. This makes it possible to draw conclusions as to the most effective form of luminescence spectrum to obtain induced radiation. A system of layers of dielectric

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Possibility of obtaining induced ...

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coatings with a certain  $R(\omega)$  dependence allows of annihilating all induced radiation frequencies other than a chosen one, where  $R$  has a peak. Thus such a system can be used as an "antifilter". There is 1 figure. The most important English-language references are: W. Kaiser et al. Phys. Rev., 123, 765, 1961; E. G. Brock et al. J. Chem. Phys. 35, 759, 1961.

ASSOCIATION: Institut fiziki AN USSR, Kiyev (Institute of Physics  
AS UkrSSR, Kiyev)

SUBMITTED: June 6, 1962

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S/185/62/007/002/007/016  
D299/D302

94177 (1051, 1114)  
X.2420

AUTHORS: Broude, V.L., and Chykovani, N.M.

TITLE: Spectral distribution of photoconductivity in CdS single-crystals at 300, 77 and 20°K

PERIODICAL: Ukrayins'kyy fizychnyy zhurnal, v. 7, no. 2, 1962, 167 - 171

TEXT: The work was reported to the First Ukrainian Congress on Physical Optics and Its Use in the National Economy, held at Kyiv in 1961. An extensive systematic study was made of the spectral distribution of photoconductivity of CdS single crystals at various temperatures; big lots of specimens were investigated. A figure shows the position of the photocurrent maxima, plotted against specimen thickness (for 100 single crystals approximately). The experimental points form 3 fairly distinct branches; hence 3 types of specimens are distinguished. The obtained data were analyzed by comparing the spectral photoconductivity-distribution and the absorption curve. The excitation spectra (of photo-

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S/185/62/001/002/007/016  
D299/D3C2

Spectral distribution of photo- ...

conductivity and luminescence) of various single-crystals at 20°K, were compared. The comparison showed that the unique correspondence between the absorption coefficient and the magnitude of the photocurrent, was disturbed. The most important results were obtained by investigating the temperature dependence of the spectral photoconductivity-distribution of various types of crystals. Thereby a typical feature was the replacement of the "anticorrelation" (absorption peaks corresponding to photoconductivity minima) distribution-curves at room- and liquid-nitrogen temperatures, by "correlation" curves (the absorption- and photocurrent peaks coincide) at liquid-hydrogen temperature. These results can be explained by assuming that the CdS single crystals have mixed (2 different types of) absorption and that the interaction between the light and the single crystals is accompanied by the formation of 2 different excitation states; no quasi-equilibrium distribution is established between these states. The 2 types of absorption are due to exciton and interband transitions; in both cases carriers are created. The relation between the two types of absorption differs with the spectral wavelength. The efficiency of carrier creation as a result of light

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Spectral distribution of photo- ...

S/185/62/007/002/007/016  
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absorption of both types, changes sharply with temperature. At low temperatures, the exciton processes of carrier creation are predominant, whereas at room temperature, the interband electron-transitions are mainly responsible for carrier creation. There are 4 figures and 7 references: 6 Soviet-bloc and 1 non-Soviet-bloc. The reference to the English-language publication reads as follows: D.G. Thomas, J.J. Hopfield, Phys. Rev., 116, 573, 1959.

ASSOCIATION: Instytut fizyki AN URSR (Institute of Physics of the AS UkrRSR), Kyiv

SUBMITTED: April 17, 1961

Card 3/3

X



BROUDE, V. L.; KOCHUBEY, S. M.

Characteristics of the spectrum of monodeuterobenzene. Opt.  
1 spektr. 13 no.6:865-867 D '62. (MIRA 16:1)

(Benzene--Spectra) (Deuterium--Spectra)

L 18740-63

EPF(c)/EWT(m)/BDS

ASD

Pr-4

RM/WW/MAY

ACCESSION NR: AT3002202

S/2941/63/001/000/0098/0102

AUTHORS: Broude, V. L.; Sheka, Ye. F.; Shpak, M. T.; Shpakovskaya, L. G.

61

TITLE: Luminescence of naphthalene crystals

SOURCE: Optika i spektroskopiya; sbornik statey. v. 1: Lyuminestsentsiya. Moscow, Izd-vo AN SSSR, 1963, 98-102

TOPIC TAGS: luminescence, electronic transition, spontaneous emission

ABSTRACT: Temperature dependence of luminescence in naphthalene crystals was studied, both in pure naphthalene samples and in 1-2% B-methylnaphthalene mixtures at 4.20 and 77K. Two types of luminescence bands are noticed: one strongly temperature-dependent, the other only moderately so. The authors maintain that the weak temperature dependence can be compared to electronic transitions between naphthalene impurity sublevels and the strong dependence with pure luminescence excitation zones. In addition, the spontaneous luminescence bands, associated with transitions from excitation zones into vibrationless levels of the ground state, are shown to be sharply polarized. Orig. art. has: 3 figures.

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BROUDE, V.L.; MOYSYA, Ye.G.

Absorption and luminescence of solutions and oriented films of  
 $\psi$ -isocyanine. Izv.AN SSSR.Ser.fiz. 27 no.4:530-532 Ap '63.  
(MIRA 16:4)

1. Institut fiziki AN UkrSSR.  
(Cyanine—Spectra)

L 10164-63

EFF(c)/EWT(1)/EWT(m)/EDS--AFFTC/

ASD/SSD--Pr-4--RM/WW/MAY

ACCESSION NR: AP3000308

S/0048/63/027/005/0596/0605

AUTHOR: Broude, V. L.; Sheka, Ye. F.; Shpak, M. T.

TITLE: Exciton luminescence of molecular crystals [Report: Eleventh Conference on Luminescence held in Minsk 10-15 Sept. 1962]

SOURCE: Izvestiya AN SSR. Seriya fizicheskaya, v. 27, no. 5, 1963, 596-605

TOPIC TAGS: molecular crystals, naphthalene, excitons, energy bands, luminescence

ABSTRACT: Observation, interpretation and identification of exciton luminescence of molecular crystals is often difficult. Analysis of luminescence data for molecular crystals shows that in many cases the observed luminescence is not due to excitons, but to impurities or defects. The specific case of low temperature luminescence of naphthalene crystals is examined and attributions are made for the different luminescence bands. Exciton series are identified. The general energy structure of naphthalene crystals can be explained in the framework of a molecular diagram, but certain distinctive features of the

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ACCESSION NR: AP3000308

2

naphthalene luminescence spectrum are specifically associated with the exciton character of its crystal structure. It is hoped that the approach to analysis of these features may help elucidate the structure of the exciton bands (zones) in this crystal and can be extended to the study of other molecular crystals. Orig. art. has: 6 figures and 1 table.

ASSOCIATION: Institut fiziki Akademii nauk USSR (Institute of Physics, Academy of Sciences, USSR)

SUBMITTED: 00

DATE ACQ: 12Jun63

ENCL: 00

SUB CODE: PH

NR REF SOV: 013

OTHER: 007

*llm/ak*  
Card 2/2

ACCESSION NR: AP4013488

S/0181/64/006/002/0354/0360

AUTHORS: Broude, V. L.; Kochubey, S. M.

TITLE: The exciton spectra of mixed crystals

SOURCE: Fizika tverdogo tela, v. 6, no. 2, 1964, 354-360

TOPIC TAGS: exciton, mixed crystal, molecular crystal, light absorption, absorption band, benzene, naphthalene

ABSTRACT: The authors have considered a previously proposed theory on exciton absorption of light in mixed molecular crystals (V. L. Broude and E. I. Rashba, FTT, 3, 1941, 1961) and have compared it with experimental data. The theory maintains that the amplitudes of excitation of different kinds of molecules occupying identical positions in the unit cell are equal. In the present comparison they have used data on mixed benzene-naphthalene crystals and have found the theory to be perfectly satisfactory for determining the position of the absorption band associated with impurity exciton zones and for determining the distribution of intensities within these zones. No deviations of theoretical results from experimental data were obtained that were greater than expected from

Card 1/2

ACCESSION NR: AP4013488

errors in measurement. "In conclusion, the authors express their thanks to E. I. Rashba and Ye. F. Sheka for active participation in and discussion of the present work." Orig. art. has: 5 figures and 3 formulas.

ASSOCIATION: Institut fiziki AN SSSR, Kiev (Institute of Physics AN SSSR)

SUBMITTED: 01Jul63

DATE ACQ: 03Mar64

ENCL: 00

SUB CODE: SS, EC

NO REF SOV: 009

OTHER: 000

Cord 2/2

ACCESSION NR: AP4012030

s/0185/64/009/001/0038/0045

AUTHOR: Broude, V. L.; Tomashchyk, O. K.

TITLE: Spectral study of thermally stressed crystalline films

SOURCE: Ukrayins'ky'y fizy\*chny'y zhurnal, v. 9, no. 1, 1964, 38-45

TOPIC TAGS: strain, thin films, absorption spectrum, naphthalene, naphthalene single crystal film, anthracene, phenanthrene, whisker crystal

ABSTRACT: The absorption spectra of thermally stressed naphthalene single crystal films adhering to a quartz support were studied at 20°K. A pronounced change in these spectra for thin films was correlated with a different mechanical behavior of these films. It was shown that naphthalene crystals with a thickness of 1.5  $\mu$  contracted by 4% along the b axis vs. their dimension at room temperature, those 0.5  $\mu$  thick by 0.5%, and those 0.2  $\mu$  thick to an infinitely small extent. A behavior similar to that of naphthalene crystals was established for anthracene and phenanthrene crystals. The phenomena observed are explained by an exceptional rigidity of very thin single-crystal films, which assume the properties of "whisker" crystals. Orig. art. has: 5 figures.

Card 1/2



ACCESSION NR: AP4012030

ASSOCIATION: Instytut Fizyki AN URSR, m. Ky'yiv (Institute of Physics, AN URSR)

SUBMITTED: 22Jun63

DATE ACQ: 14Feb64

ENCL: 00

SUB CODE: AP, PH

NO REF SOV: 007

OTHER: 000

Card 2/2

L OLS+... EWA(k) ... EMT(m)/EBC(k)-2/X/EBC(1)/T/EBC ...  
 EMT(m)/EWA ... -2/EWA ... /P1-1/P1-1/P1-1/P1-1 ...  
 ASI a ... ASD d/APET ... e)/RAEM(1)/RAEM(c)/ESD/fs/ESD ...  
 ACCESSION NR: AP40'0531 WH/UD/13 S/0185/84/009/005/001

AUTHOR: Bayborodin, Yu. V.; Broude, V. L.; Kravchenko, V. Y.; Soskin, M. S.

TITLE: On the possibility of obtaining a series of powerful single (giant) pulses with a Ruby Laser

SOURCE: Ukrayins'kyy fizychnyy zhurnal, v. 9, no. 5, 1964, 570-573

TOPIC TAGS: ruby laser, neodymium doped glass laser, laser, laser modulation, pulsed laser, giant pulse laser, laser pulse repetition frequency, laser output, laser pumping threshold, optical pumping

ABSTRACT: A method was found whereby the output pulse of a ruby laser could be broken up into a series of discrete powerful (giant) pulses with pulse repetition frequency PRF at least as great as 20kc/s. One of the disadvantages of ruby and neodymium-doped-glass lasers is the low PRF; complicated apparatus is necessary to achieve PRF's of even several cycles per second. Peak powers of these high PRF devices do not exceed 1-10 kw, and the output pulse is a nonperiodic "comb-structured" series that is inconvenient to work with. During the course of theoretical and experimental laser modulation investigations, a scheme became apparent which could yield PRF's up to several kc/s for only one flash of the pumping lamp. At

Card 1/6

L 8459-65  
ACCESSION NR: AP4039584

the very moment following the first stimulated emission pulse, the impurities are still in a relatively highly excited state; pumping power only slightly above threshold is needed to produce a second stimulated emission pulse. The flash of the pumping lamp is of the order of a millisecond, and in this scheme a chopper is inserted into the resonant cavity to chop the pumping light at frequencies of 5, 10, and 20 kc/s. The oscillograms of enclosures 01 through 03 demonstrate the effect of chopping of the pumping light. Figure 1 of the Enclosure shows the pumping pulse. This and all other figures were obtained by attenuating the output intensity by a factor of 100 before detection with a photodetector. A 20 kc/s trace from an audiooscillator is likewise supplied below each trace for calibration. Figure 2, shows the normal ruby emission when no chopper is used. Figures 3, 4, and 5 show the output when the chopper is run at PRF's of 5, 10, and 20 kc/s, respectively. It can be seen that a PRF for giant pulses of 20 kc/s is by no means an upper limit. This method is not dependent on any particular property of a three-level laser because it is a general characteristic of a laser medium to remain excited to about threshold just after the first emission. This method of controlling PRF's will be valuable in the study of the kinetics of laser emission. Orig. art. has: 5 figures.

Cord 2/6

L 8459-65  
ACCESSION NR: AP4039584

ASSOCIATION: Instytut Fizyki AN UkrSSR, Kiev (Institute of Physics, AN UkrSSR)

SUBMITTED: 24Jan64

ENCL: 03

SUB CODE: E3

NO REF SCV: 001

OTHER: 004

Card 3/6

L 8459-65  
ACCESSION NR: AP4039584

ENCLOSURE: 01

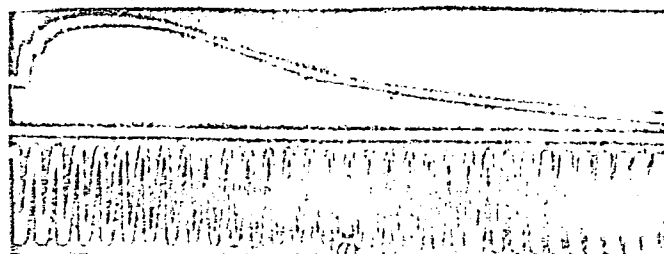


Fig. 1

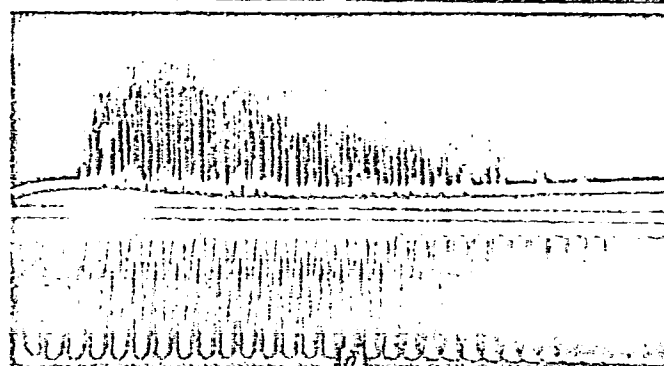


Fig. 2

Card 4/6

L 8459-65

ACCESSION NR: AP4039584

ENCLOSURE: 02

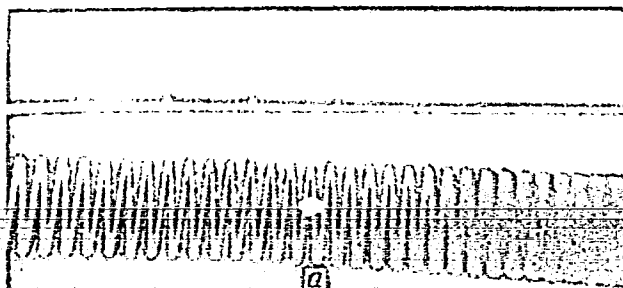


Fig. 3

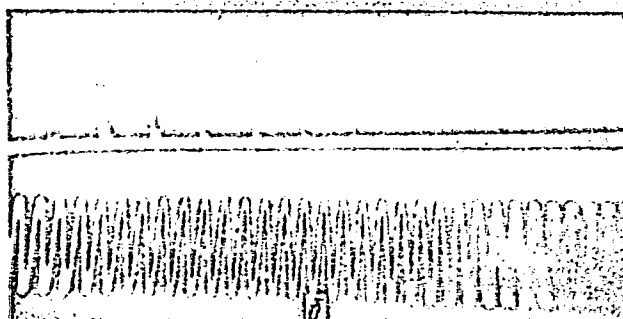


Fig. 4

Card 5/6

L 8459-65

ACCESSION NR: AP4039584

ENCLOSURE: 03

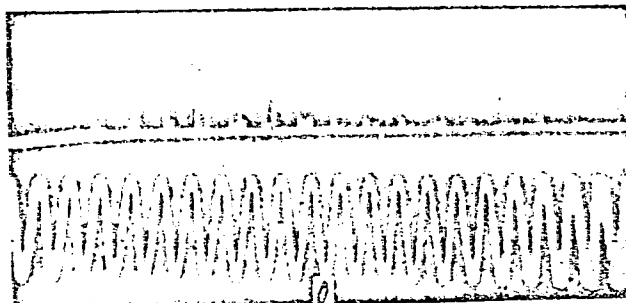


Fig. 5

For explanation of figures - see text of abstract

Card 6/6

L 23523-65 LWT(1)/EEG(t) Pob IJP(c)  
ACCESSION NR: AP4045687

S/0185/64/009/009/1031/1032

AUTHOR: Broude, V. L.; Vil'chy\*ns'ka, L. P.; Sal'kova, K. M.; Soskin, M. S.

TITLE: Characteristics of the stimulated Raman scattering<sup>2)</sup> in benzene

SOURCE: Ukrayins'ky\*y fizy\*chny\*y zhurnal. v, 9, no. 9, 1964, 1031-1032

TOPIC TAGS: stimulated Raman scattering, ruby laser, benzene light scattering, laser

ABSTRACT: The authors achieved a stimulated combination scattering (Raman scattering) in liquid benzene by placing the cell in front of a ruby laser between two dielectric mirrors (reflection coefficient for the 6200 to 7500 Å region 99.5%). The energy of the flashes of the laser pumped with two lamps of the IFP-type, was about 3.5 kj. The light from the laser and from the benzene cell was dispersed with a monochromator and the spectrum observed with a photomultiplier and an oscillograph. Two spectra were registered, one from the ruby laser, the other from the stimulated Raman scattering in benzene. Orig. art. has: 2 figures.

Cord 1/2



L 23523-65

ACCESSION NR: AP4046667

ASSOCIATION: Instytut fizyki AN URSR, Kiev (Institute of Physics AN URSR)

SUBMITTED: 25May64

ENCL: 00

SUB CODE: EC, OP

NO REF SOV: 001

OTHER: 006

Cord 2/2

L 23452-65 EWG(j)/EWA(k)/FBD/EWT(1)/EWP(e)/EWT(m)/EEC(k)-2/EEC(t)/T/EEC(b)-2/  
EWP(k)/EWA(m)-2/EWA(h) Pn-4/Po-4/Pf-4/PeB/Pl-4/Pl-4 IJP(c) WG/WE

ACCESSION NR: AP5000631

S/0185/64/009/011/1267/1268

AUTHOR: Broude, V. L.; Pogoryel'yy, O. M.; Soskin, N. S.; Stetsenko, B. V.; Yatsenko, O. P.

TITLE: Radiation fluctuations of a pulsed laser

SOURCE: Ukrayins'kyy fizychnyy zhurnal, v. 9, no. 11, 1964, 1267-1268

TOPIC TAGS: laser, pulsed laser, laser radiation intensity, ruby crystal, neodymium glass

ABSTRACT: An investigation is made of the relationship between the intensities of "spikes" radiated from two ends of a pulsed laser. A special laboratory setup was used for the measurement of laser radiation. The measurements consisted in photographing the flashes from both ends of the crystal. The intensities of "spikes" were measured (with an accuracy of 5-10%) and their ratios calculated. The ratios of radiation intensities from two resonator ends for different "spikes" within the same flash differed by as much as 20 to 40 percent. Other regularities, such as the dependence of

Cord 1/2

L 23457-65

ACCESSION NR: AP5000631

scattering on intensity and the moment of "spike" radiation within the flash were not observed. Noncorrelation of laser radiation intensity with ruby crystal and neodymium glass in the case of dielectric mirrors with a reflection coefficient close to 100 percent was approximately identical. Scattering decreases when pumping is increased above the threshold. Orig. art. has: 2 figures. [KM]

ASSOCIATION: Instytut fizyki AN URSR, Kiev. (Institute of Physics, AN UKrSSR)

SUBMITTED: 25 Jun 64

ENCL: 00

SUB CODE: EC

NO REF SOV: 005

OTHER: 001

ATD PRESS: 3174

Cord 2/2

L 6515-66 EWA(k)/FED/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c)  
 ACC NR: AP5027036 WG SOURCE CODE: UR/0120/65/000/005/0207/0210

AUTHORS: Broude, V. L.<sup>44</sup> Kravchenko, V. I.<sup>44</sup> Soskin, M. S.<sup>44</sup>

ORG: Institute of Physics, AN UkrSSR, Kiev (Institut fiziki AN UkrSSR)

TITLE: Investigation of time characteristics in the generation of giant laser pulses

SOURCE: Pribory i tekhnika eksperimenta, no. 5, 1965, 207-210

TOPIC TAGS: laser optics, laser modulation, ruby laser, laser measurement, giant pulse, Q spoiled laser

ABSTRACT: An experiment for studying the kinetics of giant laser pulse generation by using a prism-shutter system is described. Its main purpose was to relate the time change in the quality of the optical cavity to the time sweep of the generated pulse. The equipment consists of a beam-modulated laser (a ruby crystal), transmission system, measuring devices, and a circuit for oscillograph sweep trigger control. The optical cavity of the laser consists of a plane

Card 1/2

UDC: 621.378.325

09011738

L 6515-66

AGC NR: AP5027036

dielectric mirror and two 90° prisms, one of which can rotate at the rate of 20,000 rev/min. This rotary mirror increases the efficiency of the angular rate of the beam by a factor of two. The oscillographs can sweep a region of 10 nanosec to 2 μsec. Typical threshold pumping versus "nonadjustable" angle  $\varphi$  curves are obtained and are related to the losses in the cavity  $\gamma$ , or  $\gamma = f(\varphi)$ . The maximum error in the operation of the pulse generation-oscillograph sweep tying-in circuit is found to be 10". The moment of the pulse generation is determined optically, and its relation to the angular position of the rotating mirror is measured to be on the order 2 nanosec. Orig. art. has: 4 figures. [04]

SUB CODE: EG/ SUBM DATE: 21Jul64/ ORIG REF: 001/ OTH REF: 003/ ATD PRESS: 4140

nw  
Card 2/2

L 2979-66 EWP(e)/EWT(m)/EWP(i)  
ACCESSION NR: AP5025088

WH

UR/0368/65/003/003/0225/0229  
621.375.9:535.89

AUTHOR: Broude, V. L.; Zaika, V. V.; Kravchenko, V. I.; Soskin, M. S.

TITLE: The operation of a ruby laser with inclined mirrors

SOURCE: Zhurnal prikladnoy spektroskopii, v. 3, no. 3, 1965, 225-229

TOPIC TAGS: ruby laser, resonator mirror, mirror alignment

ABSTRACT: The present work originated during a study of the kinetics of giant pulse lasers with rotating prisms, where a considerable change in beam directionality was observed in comparison with the case of a fixed prism and parallel mirrors. The field distribution on the near and far mirror regions of a ruby laser and the time-varying nature of the emission were studied as a function of the degree of misalignment of a plane resonator in the direction perpendicular to the crystal optical axis. Water-cooled polished ruby crystals 120 mm long and 12 mm in diameter were used. The pumping flashlamp was placed under the crystal whose optical axis was vertical with respect to the flashlamp and whose ruby ends were parallel within 4". Dielectric-coated plane mirrors were used with reflection coefficients from 99 to 30% at 6943 Å and an adjustment within 10". The resonator length was varied from 40 to 150 cm.

Card 1/2

L 2979-66

ACCESSION NR: AP5025088

The experimental results indicate that: 1) the intensity distribution maximum is shifted in the direction of the remote edges of the mirror; 2) laser pulses from both ends of the resonator are displaced in the direction of mirror misalignment; 3) the intensity distribution in the remote region is uniform; 4) a correspondence exists between patterns for the near and remote regions for any inclination of mirrors; 5) a variation in the orientation of the longitudinal crystal axis within the resonator by an angle up to 30' does not significantly affect either the structure of the remote and near regions or the beam directionality; only a relatively small jump in the rise of pumping energy due to reflection losses at the crystal ends was observed; and 6) the amplitude and regularity of laser spikes in the case of inclined mirrors are greater than in the case of parallel mirrors, provided pumping above threshold is identical in each case. The foregoing would seem to indicate that generation in a misaligned plane resonator is, in a certain sense, more ordered and its mode structure during the entire pulse better preserved than in the case under investigation. Orig. art. has: 3 figures. [YK]

ASSOCIATION: none

SUBMITTED: 05Jan65

ENCL: 00

SUB CODE: EC

NO REF SOV: 005

OTHER: 009

ATD PRESS: 4109

Card 2/2 BYk

L 3342-66 ENT(1)/ENT(m)/ENP(j) IJP(c) RM

ACCESSION NR: AP5017304

UR/0181/65/007/007/2094/2097

AUTHORS: Broude, V. L.<sup>44,55</sup> Vlasenko, A. I.<sup>44,55</sup> Rashba, E. I.<sup>44,55</sup> Sheka, Ye. R.<sup>44,55</sup>

TITLE: Electron-vibrational luminescence of impurity centers of large radius

SOURCE: Fizika tverdogo tela, v. 7, no. 7, 1965, 2094-2097

TOPIC TAGS: luminescence spectrum, impurity center, impurity level, vibration spectrum, deuterium compound

ABSTRACT: This is a continuation of earlier work (FTT v. 5, 2361, 1963 and preceding papers) on impurity absorption in molecular crystals. In the present investigation the authors studied the spectra of electron-vibrational luminescence from impurity levels lying near the exciton bands. It is shown that in such states, the excitation in the molecular crystals is not localized entirely on the impurity molecule, but encompasses also near-lying host molecules, so that the electron-vibrational luminescence spectrum contains simultaneously bands corresponding to transitions to the vibrational levels of both

Card 1/2



L 3342-66

ACCESSION NR: AP5017304

the impurity molecules and the host. It is shown that the ratio of the intensities of these bands determines directly the square of the amplitude of the excitation of the impurity molecule in the initial state and in addition is closely related with the parameters of the purely electronic absorption spectrum. The excitation amplitudes of the impurity molecules are calculated approximately for  $C_{10}H_8$  dissolved in  $C_{10}D_8$ ,  $\beta-C_{10}HD_7$ , and  $\beta-C_{10}H_4D_4$ , as well as for  $\alpha-C_{10}H_7D$  and  $\beta-C_{10}H_7D$  dissolved in  $C_{10}D_8$ . Orig. art. has: 1 figure, 2 formulas and 1 table.

ASSOCIATION: Institut fiziki AN UkrSSR, Kiev (Institute of Physics AN UkrSSR)

SUBMITTED: 03Feb65

ENCL: 00

SUB CODE: SS, CP

NR REF SOV: 006

OTHER: 002

Card 2/2

L 2313-66 EWA(k)/FBD/EWT(1)/ENP(e)/EWT(m)/EEC(k)-2/ENP(i)/T/ENP(k)/  
EWA(m)-2/EWA(h) SCTB/TJP(c) WG/NH

ACCESSION NR: AP5021883

UR/0020/65/163/006/1342/1343

AUTHOR: Broude, V. L.; Pogorelyy, O. N.; Soskin, M. S.

TITLE: Emission on the  $R_2$  ruby line in a dispersion resonator

SOURCE: AN SSSR. Doklady, v. 163, no. 6, 1965, 1342-1343

TOPIC TAGS: solid state laser, ruby laser, laser emission, laser optics,  
dispersion resonator

ABSTRACT: The authors propose the use of dispersion systems placed in a resonator for emission on any luminescence band for tuning the working wavelength of a laser. A schematic diagram of a dispersion-type prism resonator for a laser is shown in Fig. 1 of the Enclosure. For every position of the rotating prism  $\Pi$ , there is only one definite wavelength at which the light beam passing through the prism is perpendicular to the surface of the resonator mirror K. Thus the prism (or mirror) may be rotated to close the resonator for the wavelength of the desired luminescence band. The resonator studied in this paper consisted of a ruby rod 12 cm long and 0.8 cm in diameter. The mirrors were made of a dielectric material with a reflection coefficient of ~99% in the 800-1000 m $\mu$  region. The light was dispersed by

Card 1/4

L 2313-66

ACCESSION NR: AP5021883

passing it successively through three 58° glass prisms. The glass used had an index of refraction of 2.02. The angle  $\alpha$  (see Fig. 1) was approximately 225°, and the total dispersion was about 0.25 mμ per minute of arc. The emission threshold for this dispersion laser is shown as a function of mirror alignment in Fig. 2. The point at  $\phi = 9'$  on the  $\alpha$ -axis gives the emission threshold for a beam with  $\lambda = 694.3$  mμ normal to the mirror surface. This is the  $R_1$  emission ordinarily observed in ruby lasers. The point at  $\phi = 3'$  is the emission threshold at 692.29 mμ (the  $R_2$  ruby line). Spectrograms of the laser emission were taken, and the intensity distribution in the long-range zone was measured for the points marked 1-5 in Fig. 2. Emission at points 1 and 2 consists of a single line with a wavelength of 692.9 mμ ( $R_2$ ), a 694.3-692.9 mμ doublet was observed at point 3, and points 4 and 5 showed emission only on the 694.3 mμ line ( $R_1$ ). Unstable conditions are observed at certain mirror angles. In these cases, emission takes place on a single line or on both lines simultaneously. It is suggested that this instability should be further investigated for the specific case of near-lying energy levels. Orig. art. has: 2 figures. [14]

ASSOCIATION: Institut fiziki Akademii nauk UkrSSR (Institute of Physics, Academy of Sciences, UkrSSR)

SUBMITTED: 04Feb65

NO REF SOV: 002

ENCL: 02

OTHER: 002

SUB CODE: EC, OP

Card 2/4

A.T.D. PRESS 4104

L-2313-66

ACCESSION NR: AP5021883

ENCLOSURE: 01

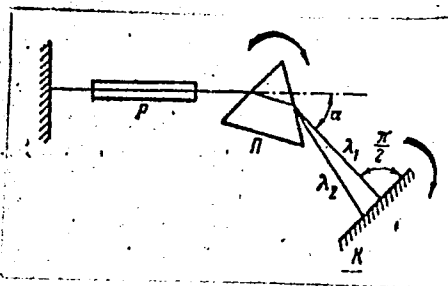


Fig. 1. Schematic of dispersion-type prism resonator

P - Ruby rod;  $\Pi$  - dispersion prism;  
K - end mirror of the resonator.

Card 3/4

L 2313-66

ACCESSION NR: AP5021883

ENCLOSURE: 02

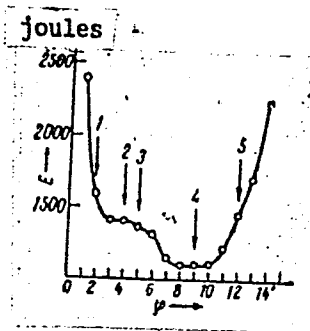


Fig. 2. Emission threshold for dispersion resonator

Card 4/4 *hd*

BROUDE V.L.; KRAVCHENKO, V.I.; PROKOPIYUK, N.F.; SOSKIN, M.S.

Spectral composition of the generation from neodymium glass in a dispersion resonator. Pis'ma v red. Zhur. eksper. i teoret. fiz. 2 no. 11:519-521 D '65.

1. Institut fiziki AN UkrSSR, Kiev. Submitted October 21, 1965.

L 45862-66 EWT(1)/EEC(k)-2/T/EWP(k) IJP(c) WG/GD

ACC NR: AT6015141

SOURCE CODE: UR/0000/66/000/000/0188/0213

AUTHOR: Broude, V. L.; Sheka, Ye. F.

ORG: Institute of Physics, AN UkrSSR (Institut fiziki AN UkrSSR)

TITLE: Luminescence on an intense excitation

SOURCE: Respublikanskiy seminar po kvantovoy elektronike. Kvantovaya elektronika (Quantum electronics); trudy seminara. Kiev, Naukova dumka, 1966, 188-213

TOPIC TAGS: luminescence, luminescent crystal, luminescence center, laser theory

ABSTRACT: The kinetic equations used by V. S. Mashkevich ("Kinetic basis of laser radiation," Naukova dumka publishers, Kiev, 1966) are employed, in the present article, for deducing the laws of luminescence intensity and spectral distribution in a system (a crystal) receiving high-power excitation. Under stationary conditions in a homogeneous system, the radiation spectral distribution depends on these three factors: (1) Addition of induced transitions, (2) Population of the final level that takes part in a transition, (3) Geometric structure of the luminescent system. Mode distribution of photons depending on the number of excited centers and the exciting-

Cord 1/2

L 45862-66

ACC NR: AT6015141

light intensity is analyzed. A simultaneous exciton and extrinsic luminescence, when the induced radiation transitions are not the only cause of possible redistribution of intensity in the luminescence spectrum, is examined. The above theory is used in calculating exciton-luminescence of molecular crystals (anthracene). The effect of pumping on spectral distribution is found by using an experimental exciton-luminescence spectrum of anthracene measured at 77K. Both exciton and extrinsic luminescences of high-power excited anthracene crystals were experimentally studied. Such crystals appear promising in the development of multifrequency lasers. 15  
 "The cryostat was developed by V. S. Medvedev at the Institute of Physics, AN UkrSSR. A student of the Kiev State University, N. S. Belokrinskiy, took part in the investigation ...." Orig. art. has: 13 figures, 72 formulas, and 2 tables.

SUB CODE: 20 / SUBM DATE: 12Feb66 / ORIG REF: 013 / OTH REF: 002

Card 2/2 ULR



L 27734-66 FBD/EWT(1)/EWP(e)/EWT(m)/EEC(k)-2/T/EWP(k)/EWA(h) LJP(c) WQ/GB

ACC NR: AT6015135 WH

SOURCE CODE: UR/0000/66/000/000/0123/0136

AUTHOR: Broude, V. L.; Soskin, M. S.

59  
Bx1

ORG: Institute of Physics AN UkrSSR (Institut fiziki AN UkrSSR)

TITLE: Laser with adjustable frequency

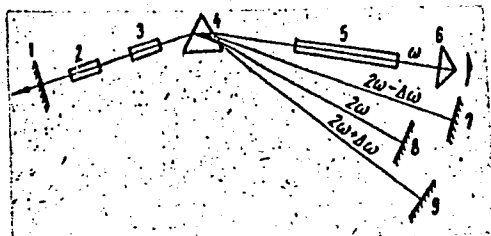
SOURCE: Respublikanskiy seminar po kvantovoy elektronike. Kvantovaya elektronika (Quantum electronics); trudy seminarov. Kiev, Naukova dumka, 1966, 123-136

TOPIC TAGS: Raman scattering, ruby laser, solid state laser, piezoelectric crystal, laser optics

ABSTRACT: The authors consider two methods for changing the working frequency of a solid state laser: 1. changing the spectral properties of the laser resonator, and 2. interactions between a powerful beam of induced emission and nonlinear media resulting in multiphonon processes. A review of the literature shows that these two methods may be used for producing additional working frequencies which differ from the fundamental frequency for a given active solid during free emission. A new laser system is proposed for emission in various spectral positions with provision for adjustment from one working frequency to another and some of the problems involved in producing such a system are discussed. A block diagram of the proposed multifrequency laser is shown in the figure. The system is based on a ruby, a KDP crystal and a li-

Card 1/2

ACC NR: AT6015135



Optical system for a laser with adjustable frequency: 1,7-9--mirrors; 2--nonlinear elements; 3--element for producing induced Raman scattering; 4--dispersion prism; 5--active solid; 6--rotating prism

quid benzene specimen for stimulated Raman scattering. Since emission of Stokes and anti-Stokes components at  $992 \text{ cm}^{-1}$  and their harmonics is possible in benzene, there are 8 or 9 different frequencies with an interval of  $992 \text{ cm}^{-1}$  in the region of the second harmonic for ruby on which laser action may be attained. The basic problems which must be solved to produce such a laser are briefly discussed. Orig. art. has: 8 figures. [14]

SUB CODE: 20/

SUBM DATE: 12Feb66/

ORIG REF: 012/

OTH REF: 014/

ATD PRESS: 5002

Card 2/2 BLG

L 27749-66 EMT(1)/T LJP(c) GO

ACC NR: AP6018699

SOURCE CODE: UR/0386/66/003/011/0429/0434

AUTHOR: Broude, V. L.; Rashba, E. I.; Sheka, Ye. F. 48

ORG: Institute of Physics, Academy of Sciences Ukrainian SSR (Institut fiziki Akademii nauk Ukrainiskoy SSR) B

TITLE: Collective effects in vibron spectra of molecular crystals

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 3, no. 11, 1966, 429-434

TOPIC TAGS: light absorption, absorption spectrum, electron transition, naphthalene, paraffin wax, deuterium, vibration spectrum, particle interaction, exciton

ABSTRACT: To check on a hypothesis recently advanced by one of the authors (Rashba, ZhETF v. 50, 1164, 1966) that two-particle absorption plays an important role in the interpretation of electron-vibrational (vibron) transitions in the absorption spectra of molecular crystals, the authors measured the absorption spectra of pure and deuterated naphthalene and paraffin in the region of the first vibron transition and confirmed the presence of a two-particle band in the spectrum which is shifted to the long-wave side relative to the maximum of the state density of the pure-electronic exciton band. The experiments also disclosed the presence of two additional vibron bands corresponding to vibrational excitation at the impurity molecule and in its vicinity. These agree well with Rashba's hypothesis and confirm the strong influence of collective effects (decay processes) on the vibron spectrum and

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ACC NR: AP6018699

the presence in this spectrum of two branches corresponding to single- and two-particle absorption. The latter is estimated to reach 50% of the total vibron transition. It is proposed that the two-particle absorption can play an important role in the interpretation of the known structure background of the absorption of molecular crystals and the determination, from this interpretation, of many new parameters of exciton bands. Orig. art. has: 2 figures.

SUB CODE: 20/ SUBM DATE: 30Mar66/ ORIG REF: 010/ OTH REF: 001

Card 2/2

L 28378-66 EEC(k)-2/EWA(h)/EWP(j)/EWP(k)/EWT(l)/EWT(m)/FBD/T IJA(c) GG/RM/

ACC NR: AP6016053

WH/WG/WW

SOURCE CODE: UR/0185/66/011/005/0569/0570

AUTHOR: Broude, V. L.; Pohorets'kyi, P. P.; Sal'kova, K. M.; Soskin, M. S. 50  
B

ORG: Institute of Physics, AN URSSR, Kiev (Instytut fizyky AN URSSR)

TITLE: Stimulated Raman scattering of light by benzene in the dispersion resonator of a ruby laser

SOURCE: Ukrayins'kyi fizychnyy zhurnal, v. 11, no. 5, 1966, 569-570

TOPIC TAGS: Raman scattering, ruby laser, laser emission

ABSTRACT: An investigation was made of stimulated Raman scattering (SRS) by benzene in the dispersion resonator (see Fig. 1) of a ruby laser.<sup>25</sup> In a resonator with two heavy flint glass prisms, the angular separation of the ruby emission and the Raman scattering at a frequency of  $992 \text{ cm}^{-1}$  reached  $2^\circ$ . The transmittivity of the mirrors was approximately 5%. A container 15 cm long with glass windows was filled with pure benzene. Q-switching was achieved by using 10-mm-thick KS-18 glass in the resonator. The ruby radiation consisted of a series of separate pulses, each with an average power close to  $10 \text{ kwatt/cm}^2$  and a length of 500 nsec, with pump level 30% above threshold. Intensive stimulated Raman scattering was observed in the dispersion resonator during ruby generation exceeding the threshold by 10-20%. It should be noted that SRS was observed when mirror 3 was unaligned and even when it was absent. Changes in the far zone of SRS and the ruby emission behind mirror 2 when the benzene-

Cord 1/2

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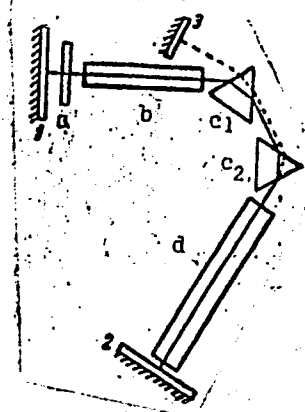


Fig. 1. Diagram of dispersion resonator

1, 2, 3 - Mirrors; a - KS-18 glass; b - ruby;  
c<sub>1</sub>, c<sub>2</sub> - prisms; d - benzene-filled vessel.

filled vessel was turned up to  $4^\circ$  (in either the horizontal or vertical plane) showed that the direction of SRS generation does not depend on the orientation of the vessel and its windows and is always perpendicular to mirror 2. When the ruby generation threshold was exceeded by 30% the efficiency of the transformation of ruby emission into SRS approached 10%. Orig. art. has: 1 figure. [JA]

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Card 2/2 CC

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AUTHOR: Broude, V. L.; Rashba, E. I.; Sheka, E. F.

ORG: Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev

TITLE: A new approach to the vibronic spectra of molecular crystals

SOURCE: Physica status solidi, v. 19, no. 1, 1967, 395-406

TOPIC TAGS: crystal absorption, <sup>spectrum</sup> exciton, naphthalene, molecular crystal, Coulomb  
excitation, absorption band

ABSTRACT:

Crystal absorption spectra are considered in the light of a recently developed theory which assumes the presence of interactions between the vibrational, electronic, and vibrational-electronic (vibronic) excitations, in particular a decay of vibronic intramolecular excitations into pure electronic and intramolecular-vibrational excitations of separate molecules [E. I. Rashba, Zh. E. T. F., v. 50, 1966, 1064—1080, transl. Soviet Physics JETP, v. 23, 708—718].. These interactions affect the distribution of one-particle excitations (concurrent propagation of an exciton and a phonon) and two-particle excitations (independent propagation of the exciton and photon). These collective processes are illustrated by means of simplified models. Their influence on absorption spectra is investigated, the most important effect being regarded as a reduction of the vibrational frequency of the molecule

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accompanying its electronic excitation. Interpretation of available data on molecular absorption bands of both pure and isotope (deuterium)-doped naphthalene crystals is then presented in considerable detail. These data are in good agreement with the theory. The authors thank Dr. M. S. Saskin for providing and discussing these data. Orig. art. has: 2 formulas and 5 figures. [JM]

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Card 2/2



24(6)

SOV/179-59-4-39/40

AUTHORS: ~~Broude, V. M., Pshenichnov, G. I.~~

TITLE: Remark on the Article by A. P. Filin "On the Stability of Prestressed Construction Elements" (Izvestiya AN USSR, OTN, Nr 12, 1957)

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye tekhnicheskikh nauk. Mekhanika i mashinostroyeniye, 1959, Nr 4, p 200 (USSR)

ABSTRACT: An error in the paper by Filin is pointed out. It is shown that, under the conditions assumed there, the critical P-value cannot depend on  $P_0$ . Equation (2.4) neglects the term considering the work of the initial force in the concrete at the bulging of the bar. By correcting this error, the term with  $P_0$  disappears.

Card 1/1

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p. 1839. (TEHNIKA, Vol. 9, no. 11, 1954. Beograd, Yugoslavia)

SC: Monthly List of East European Accessions, (EAL), 18, Vol. 4, No. 4,  
Apr 1955, Uncl.

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Česk. zdravot. 6 no.7:375-379 July 58.

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